summing in-phase and quadrature phase parts of the output signal outputted from a plurality of blocks as

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$(\sum_{n=1}^{K}((W_{M,n1}X_{n1} + jW_{M,n2}X_{n2}) \times (W_{M,n3} + jW_{M,,n4})))$, K is a predetermined integer greater than or equal to 1 to generate I channel and Q channel signal.

CONT

2 ~~42~~. The method of claim 1 ~~41~~ wherein a spreading code spreads the summed in-phase and quadrature-phase signals outputted from the summing step.

3 ~~43~~. The method of claim 1 ~~41~~ wherein said orthogonal code sequence includes a Hadamard code sequence.

4 ~~44~~. The method of claim 1 ~~41~~ wherein said orthogonal code sequence includes a Walsh code.

5 ~~45~~. The method of claim 2 ~~42~~ wherein said spreading code is one spreading code.

6 ~~46~~. The method of claim 5 ~~45~~ wherein said spreading code sequence includes a PN code.

7 ~~47~~. The method of claim 5 ~~45~~ wherein said spreading code includes a first spreading code for the in-phase signal and a second spreading code for the quadrature-phase signal.

8 ~~48~~. The method of claim 7 ~~47~~ wherein the first and second spreading codes are PN codes.

9 ~~49~~. The method of claim 3 ~~43~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,13}=W_0$, $W_{M,14}=W_1$, when M=4.

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10 ~~50~~. The method of claim 9 ~~49~~ wherein $M=8$ and $W_{M,12}=W_4$.

11 ~~51~~. The method of claim 3 ~~43~~ wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_{2p}$, where p represents a predetermined number in a range from 0 to (M/2)-1, and $W_{M,n3}=W_{2n-2}$, $W_{M,n4}=W_{2n-1}$.

A1 CONT

12 ~~52~~. The method of claim 3 ~~43~~ wherein $W_{M,21}=W_0$, $W_{M,22}=W_4$, $W_{M,23}=W_2$, $W_{M,24}=W_3$ when M=8 in case of two channels.

13 ~~53~~. The method of claim 12 ~~52~~ wherein $W_{M,12}=W_6$, and $W_{M,22}=W_6$.

14 ~~54~~. An orthogonal complex spreading apparatus, comprising:

a plurality of complex multiplication blocks, each for complex-multiplexing a complex signal $W_{M,n1}X_{n1}+j\,W_{M,n2}X_{n2}$ by $W_{M,n3}+jW_{M,n4}$ wherein $W_{M,n1}X_{n1}$ is obtained by multiplying an orthogonal code sequence $W_{M,n1}$ by first data group X_{n1} of n-th block and $W_{M,n2}X_{n2}$ is obtained by multiplying orthogonal sequence $W_{M,n2}$ by second data group X_{n2} of the n-th block, wherein M and n are positive integers and $W_{M,n1}$, $W_{M,n2}$, $W_{M,n3}$ and $W_{M,n4}$ are predetermined orthogonal sequences; and

a summing unit for summing in-phase and quadrature phase parts of an output signal from each block of the plurality of the complex multiplication blocks as

T,0420 $$\left(\sum_{n=1}^{K}((\alpha_{n1}W_{M,n1}X_{n1} + j\alpha_{n2}W_{M,n2}X_{n2}) \times (W_{M,n3} + jW_{M,,n4}))\right),$$ K is a predetermined integer greater than or equal to 1.

15 ~~55~~. The apparatus of claim 14 ~~54~~ further comprising a spreading unit for multiplying the summed in-phase and quadrature phase signals inputted from the summing unit by spreading code.

16 ~~56~~. The apparatus of claim 15 ~~55~~ wherein said spreading unit multiplies the in-phase and quadrature phase part by different spreading codes.

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17 ~~57~~. The apparatus of claim 14 ~~54~~ wherein each said complex multiplication block includes:

a first multiplier for multiplying the first data group X_{n1} by the orthogonal code sequence $W_{M,n1}$;

a second multiplier for multiplying the second data group X_{n2} by the orthogonal code sequence $W_{M,n2}$;

third and fourth multipliers for multiplying the output signal $W_{M,n1}X_{n1}$ from the first multiplier and the output signal $W_{M,n2}X_{n2}$ from the second multiplier by orthogonal code sequence $W_{M,n3}$;

fifth and sixth multipliers for multiplying the output signal $W_{M,n1}X_{n1}$ from the first multiplier and the output signal $W_{M,n2}X_{n2}$ from the second multiplier by orthogonal code sequence $W_{M,n4}$;

a first adder for subtracting output signal from the sixth multiplier from output signal (ac) from the third multiplier and outputting an in-phase information; and

a second adder for summing output signal from the fourth multiplier and output signal from the fifth multiplier and outputting quadrature phase information.

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58. The method of claim 57 wherein said orthogonal code sequence includes a Hadamard code sequence.

59. The method of claim 57 wherein said orthogonal code sequence includes a Walsh code.

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~~60~~ 20. A permuted orthogonal complex spreading method for multiple channels allocating at least two input channels to first and second groups, comprising the steps of:

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multiplying a predetermined orthogonal code sequence $W_{M,n1}$ by first data group X_{n1};

multiplying orthogonal code sequence $W_{M,n2}$ by second data group X_{n2};

summing output signals $W_{M,n1}X_{n1}$ and $W_{M,n2}X_{n2}$ in the complex form of

T10440

$$\sum_{n=1}^{K}(W_{M,n1}X_{n1} + jW_{M,n2}X_{n2})$$; and

complex-multiplying the received output signal

T10441

$\sum_{n=1}^{K}(W_{M,n1}X_{n1} + jW_{M,n2}X_{n2})$ by $(W_{M,I}+jPW_{M,Q})$, wherein P is a predetermined sequence, and $W_{M,I}$ and $W_{M,Q}$ are orthogonal code sequences.

~~61~~ 21. The method of claim ~~60~~ 20 wherein the spreading code is a PN code.

~~62~~ 22. The method of claim ~~60~~ 20 wherein P represents said predetermined sequence or predetermined spreading code or predetermined integer configured so that two consecutive sequences have identical values.

C ~~63~~ 23. The method of claim ~~57~~ ~~60~~ 20 wherein said orthogonal code sequence includes a Hadamard code sequence.

C ~~64~~ 24. The method of claim ~~57~~ ~~60~~ 20 wherein said orthogonal code sequence includes a Walsh code.

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25 ~~65~~. The method of claim 23 ~~63~~ wherein $W_{M,I}=W_0$, $W_{M,Q}=W_{2q+1}$ (where q represents a predetermined number in a range from 0 to (M/2)-1).

26 ~~66~~. The method of claim 23 ~~63~~ further comprising the steps of:

multiplying the first data group X_{n1} by gain α_{n1}; and

multiplying the second data group X_{n2} by gain α_{n2}.

27 ~~67~~. The method of claim 23 ~~63~~ wherein $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$, when M=4.

28 ~~68~~. The method of claim 27 ~~67~~ wherein M=8 and $W_{M,12}=W_4$.

29 ~~69~~. The method of claim 23 ~~63~~ wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_{2q+1}$, wherein q represents a predetermined number in a range from 0 to (M/2)-1 and $W_{M,I}=W_0$, $W_{M,Q}=W_1$.

30 ~~70~~. The method of claim 20 ~~60~~ wherein each group has at least two channels and the receiving step includes the steps of:

summing output signals $W_{M,n1}X_{n1}$ from a first sequence multiplier; and

summing output signals $W_{M,n2}X_{n2}$ from a second sequence multiplier.

A1 CONT

31 ~~71~~. A permuted orthogonal complex spreading apparatus for multiple channels, allocating at least two input channels to first and second groups, comprising:

a first multiplier block having at least one channel contained in a first group of channels, each for outputting $W_{M,n1}X_{n1}$ which is obtained by multiplying first data group X_{n1} by orthogonal code sequence $W_{M,n1}$, M and n are positive integers;

a second multiplier block having a number of channels having at least one channel contained in a second group of channels, each for outputting $W_{M,n2}X_{n2}$ which is obtained by multiplying a first data group X_{n2} by orthogonal code sequence $W_{M,n2}$;

a complex multiplier for receiving the output signals from the first and the second multiplier blocks in a complex form of

T,0460 $\sum_{n=1}^{K}(W_{M,n1}X_{n1}+jW_{M,n2}X_{n2})$, and complex-multiplying received output

signal by $W_{M,I}+jPW_{M,Q}$, wherein $W_{M,I}$ and $W_{M,Q}$ are predetermined

orthogonal code sequence permuted and P is a predetermined sequence.

32 ~~72~~. The apparatus of claim 31 ~~71~~ wherein said orthogonal code sequence includes a Hadamard code sequence.

33 ~~73~~. The apparatus of claim 31 ~~71~~ wherein said orthogonal code sequence includes a Walsh code.

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~~74~~ 34. The apparatus of claim ~~72~~ 32 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$, when M=8 in case of three input channels.

~~75~~ 35. The apparatus of claim ~~72~~ 32 wherein $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of three input channels.

~~76~~ 36. The apparatus of claim ~~72~~ 32 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of four input channels.

~~77~~ 37. The apparatus of claim ~~72~~ 32 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,31}=W_2$, $W_{M,I}=W_0$, $W_{M,Q}=W_1$ and $W_{M,21}=W_8$ in case of four input channels.

~~78~~ 38. The apparatus of claim ~~72~~ 32 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, $W_{M,22}=W_1$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of five input channels.

~~79~~ 39. The apparatus of claim ~~72~~ 32 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, $W_{M,22}=W_3$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of five channels.

~~80~~ 40. The apparatus of claim ~~71~~ 31 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,31}=W_2$, $W_{M,22}=W_6$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ and $W_{M,21}=W_8$ in case of five input channels.

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A1 CONT

41 ~~81~~. The apparatus of claim ~~76~~ 36 wherein $W_0X_{11}+jW_4X_{12}$, W_2X_{21} and W_6X_{31} are replaced by $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$, $\alpha_{21}W_2X_{21}$ and $\alpha_{31}W_6X_{31}$, and a gain α_{n1} and a gain α_{n2} are the identical gain in order to remove the phase dependency by an interference occurring in a multipath of a self signal and an interference occurring by other users.

42 ~~82~~. The apparatus of claim ~~71~~ 31 wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$.

43 ~~83~~. The apparatus of claim ~~71~~ 31 wherein the first multiplier block comprises at least a third multiplier for multiplying the first data group X_{n1} by gain α_{n1}, and the second multiplier block comprises at least a fourth multiplier the second data group X_{n2} by gain α_{n2}.

44 ~~84~~. The apparatus of claim ~~72~~ 32 wherein $W_{M,11}=W_0$, $W_{M,12}=W_{4/1}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/4}$, when M=8 in case of two input channels.

45 ~~85~~. The apparatus of claim ~~72~~ 32 wherein $W_{M,11}=W_0$, $W_{M,12}=W_{4/1}$, $W_{M,21}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/4}$, when M=8 in case of three input channels.

46 ~~86~~. The method of claim ~~72~~ 32 wherein $W_{M,11}=W_0$, $W_{M,12}=W_{2/1}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/2}$, when M=8 in case of two input channels.

47 ~~87~~. The apparatus of claim ~~72~~ 32 wherein $W_{M,11}=W_0$, $W_{M,12}=W_{2/1}$, $W_{M,21}=W_4$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/2}$, when M=8 in case of three input channels.

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48 ~~88~~. The apparatus of claim 31 ~~71~~ wherein each group has at least the two input channels, further comprising:

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a first adder for outputting

T1,0490 $\sum_{n=1}^{K} (W_{M,n1}X_{n1})$ by summing output signals from the first multiplier block; and

a second adder for outputting

T1,0491 $\sum_{n=1}^{K} (W_{M,n2}X_{n2})$ by summing output signals from the second multiplier block.

49 ~~89~~. The apparatus of claim 31 ~~71~~ further comprising:

a spreading unit for multiplying the signal

T1,0492 $\sum_{n=1}^{K} (W_{M,n1}X_{n1}+jW_{M,n2}X_{n2})$ received by the complex multiplier by a spreading code.

50 ~~90~~. The apparatus of claim 49 ~~89~~ wherein the spreading unit respectively multiplies the in-phase and quadrature-phase parts by different spreading codes.

51 ~~91~~. The apparatus of claim 31 ~~71~~ wherein $W_{M,n1}$, $W_{M,n2}$, $W_{M,I}$, and $W_{M,Q}$ are orthogonal Hadamard sequences.

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A1 CONT

52 ~~92~~. The apparatus of claim 31 ~~71~~ wherein the complex multiplier includes:

fifth and sixth multipliers for multiplying said output signal from the first multiplier block and said output signal from the second sequence multiplier by orthogonal sequence $W_{M,I}$;

seventh and eighth multipliers for multiplying said output signal from the first multiplier block and output signal $\alpha_{n2}W_{M,n2}X_{n2}$ from the second multiplier block by orthogonal sequence $W_{M,Q}$;

a third adder for subtracting output signal from the eighth multiplier from output signal from the fifth multiplier to output an in-phase information; and

a second adder for summing output signal from the sixth multiplier and output signal from the seventh multiplier to output quadrature-phase information.

53 ~~93~~. A permuted orthogonal complex spreading apparatus for multiple channels, allocating at least two input channels into first and second groups, comprising:

first and second multiplier blocks for respectively multiplying first and second data group X_{n1}, and X_{n2} with a set of predetermined orthogonal sequences $W_{M,n1}$, and $W_{M,n2}$ to output $W_{M,n1} X_{n1}$ and $W_{M,n2} X_{n2}$;

a complex multiplier for receiving the output signals $W_{M,n1} X_{n1}$ and $W_{M,n2} X_{n2}$ from the first and the second multiplier blocks in the complex form of

T,0500

$$\sum_{n=1}^{K}(W_{M,n1}X_{n1}+jW_{M,n2}X_{n2})$$

and multiplying a received signal

T,0501

$$\sum_{n=1}^{K}(W_{M,n1}X_{n1}+jW_{M,n2}X_{n2})$$

by a predetermined sequence $(W_{M,I} + jPW_{M,Q}) \times SC$, wherein $W_{M,I}$, $W_{M,Q}$ are predetermined orthogonal sequences, P is a predetermined sequence and SC is a spreading sequence.

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54 ~~94~~. The apparatus of claim 53 ~~93~~ wherein each group has at least two input channels, further comprising:

a first adder for outputting

CONT 7,0510 $\sum_{n=1}^{K} (W_{M,n1}X_{n1})$ by summing output signals from the first sequence multiplier; and

a second adder for outputting

7,0511 $\sum_{n=1}^{K} (W_{M,n2}X_{n2})$ by summing output signals from the second sequence multiplier.

55 ~~95~~. The apparatus of claim 53 ~~93~~ wherein the first sequence multiplier comprises at least one first gain multiplier for multiplying the data X_{n1} of each channel of the first group by gain α_{n1}, and the second sequence multiplier comprises at least one second gain multiplier for multiplying the data X_{n2} of each channel of the second group by gain α_{n2}.

56 ~~96~~. The apparatus of claim 53 ~~93~~ wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_{2p}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$, where p represents a predetermined integer in a range from 0 to (M/2)-1.

57 ~~97~~. The apparatus of claim 53 ~~93~~ wherein $W_{M,n1}$, $W_{M,n2}$, $W_{M,I}$, and $W_{M,Q}$ are orthogonal Hadamard sequences.--